IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of:

Appellants	:	Bruce W. Melvin et al.
Application No.	:	10/730,390
Filed	:	December 8, 2003
For	:	METHOD AND SYSTEM FOR OUPUT FLOW CONTROL IN NETWORK MULTIPLEXERS

Examiner	:	ELPENORD, Candal
Art Unit	:	2616
Docket No.	:	10991796-2
Date	:	February 17, 2010

APPEAL BRIEF

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Sir:

This appeal is from the decision of the Examiner, in an Office Action mailed September 17, 2009, finally rejecting claims 1, 3, 6-8, 10 and objecting to claims 2, 4, 5 and 9.

REAL PARTY IN INTEREST

The real party in interest is Hewlett-Packard Development Company, LP, a limited partnership established under the laws of the State of Texas and having a principal place of business at 20555 S.H. 249 Houston, TX 77070, U.S.A. (hereinafter "HPDC"). HPDC is a Texas limited partnership and is a wholly-owned affiliate of Hewlett-Packard Company, a Delaware Corporation, headquartered in Palo Alto, CA. The general or managing partner of HPDC is HPQ Holdings, LLC.

RELATED APPEALS AND INTERFERENCES

Appellants' representative has not identified, and does not know of, any other appeals of interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

STATUS OF CLAIMS

Claims 1-10 are pending in the application. Claims 1, 3, 6-8, 10 and objected claims 2, 4, 5 and 9 were finally rejected in an Office Action dated September 17, 2009. Appellants' appeal the final rejection of claims 1, 3, 6-8, 10 and objected claims 2, 4, 5 and 9 which are copied in the attached CLAIMS APPENDIX.

STATUS OF AMENDMENTS

No Amendment After Final is enclosed with this brief. The last Response was filed July 1, 2009. The last amendment to the claims was filed August 29, 2007.

SUMMARY OF CLAIMED SUBJECT MATTER

Independent Claim 1

Claim 1 is directed to a method for initiating flow control (lines 3-7 of page 3; lines 6-7 of page 21; lines 13-20 of page 24; line 59 in Figure 14B; and line 106 in Figure 14C) in a network multiplexer (lines 15-26 of page 1; 114 in Figure 1; 700 in Figure 7) that forwards a message descriptor (lines 23-24 of page 1) referencing a communications packet received by a receiving port (702-707 in Figure 7; line 26 of page 8 to line 14 of page 10) to one or more transmit queues (708 in Figure 7; line 26 of page 8 to line 14 of page 10), each transmit queue associated with a transmitting port (702-707 in Figure 7; line 26 of page 8 to line 14 of page 10) which transmits communications packets queued to the transmit queue, the method comprising: (1) providing each transmitting port in the network multiplexer with a high threshold (lines 7-10 of page 15; 1314 in Figure 13A) and a low threshold (lines 7-10 of page 15; 1316 in Figure 13A); and (2) when a message descriptor is queued to a transmit queue associated with a transmitting port, (2a) when the transmit queue currently contains a maximum number of message descriptors, discarding the message descriptor (lines 27-29 of page 15), and (2b) when the transmit queue currently contains a number of message

descriptors equal to or greater than the high threshold of the associated transmitting port, sending a flow control request (line 29 of page 15 to line 3 of page 16) to the receiving port that received the communications packet referenced by the queued message descriptor.

Dependent Claims 2-5

Claim 2 is directed to the method of claim 1 that further includes, when a message descriptor (lines 23-24 of page 1) is queued to a transmit queue (708 in Figure 7; line 26 of page 8 to line 14 of page 10) associated with a transmitting port (702-707 in Figure 7; line 26 of page 8 to line 14 of page 10), when the transmit queue currently contains a number of message descriptors greater than or equal to the low threshold (lines 7-10 of page 15; 1316 in Figure 13A) of the associated transmitting port, but the number of message descriptors contained in the transmit queue exceeded or equaled the high threshold (lines 7-10 of page 15; 1314 in Figure 13A) of the associated transmitting port more recently than the number of message descriptors contained in the transmit queue was equal to the low threshold of the associated transmitting port, sending a flow control request (line 29 of page 15 to line 3 of page 16) to the receiving port that received the communications packet referenced by the queued message descriptor. Claim 3 is directed to the method of claim 1 further including: when a transmitting port (702-707 in Figure 7; line 26 of page 8 to line 14 of page 10) transmits a packet referenced by a message descriptor (lines 23-24 of page 1) to a destination port, releasing the message descriptor, and when the destination port currently contains a number of queued message descriptors equal to one less than the destination port's low threshold (lines 7-10 of page 15; 1316 in Figure 13A), sending a release flow control request (line 29 of page 15 to line 3 of page 16) to any receiving ports (702-707 in Figure 7; line 26 of page 8 to line 14 of page 10) to which a flow control request was sent while the transmit queue (708 in Figure 7; line 26 of page 8 to line 14 of page 10) contained a number of message descriptors equal to or greater than the high threshold (lines 7-10 of page 15; 1314 in Figure 13A) of the associated transmitting port. Claim 4 is directed to the method of claim 2 further including: when a transmitting port (702-707 in Figure 7; line 26 of page 8 to line 14 of page 10) transmits a packet referenced by a message descriptor (lines 23-24 of page 1) to a destination port, releasing the message descriptor, and when the destination port currently contains a number of queued message descriptors one less than the destination port's low threshold (lines 7-10 of page 15; 1316 in Figure 13A), sending a release flow control request (line 29 of page 15 to line 3 of page 16) to any receiving ports to which a flow

control request was sent while the transmit queue (708 in Figure 7; line 26 of page 8 to line 14 of page 10) contained a number of message descriptors greater than or equal to the low threshold of the associated transmitting port. Claim 5 is directed to the method of claim 4 further including, when a receiving port (702-707 in Figure 7; line 26 of page 8 to line 14 of page 10) is flow controlled (line 29 of page 15 to line 3 of page 16) and receives a number of release flow control requests equal to the number of received flow control requests, releasing flow control by the receiving port.

Independent Claim 6

Claim 6 is directed to a network multiplexer (lines 15-26 of page 1; 114 in Figure 1; 700 in Figure 7) system that links physically separate network media by forwarding packets received from each network medium to a number of network media, the network multiplexer system comprising: (1) a number of ports (702-707 in Figure 7; line 26 of page 8 to line 14 of page 10), each port having a transceiver and a communications controller; (2) a memory (712 and 714 in Figure 7; lines 2-5 of page 9; 324 in Figure 3; line 22 of page 5 to line 6 of page 6); (3) an internal bus for transferring packets from ports to memory and from memory to ports (322 in Figure 3; line 22 of page 5 to line 6 of page 6); (4) a receive queue (710 in Figure 7; line 26 of page 8 to line 14 of page 10) and a transmit queue (708 in Figure 7; line 26 of page 8 to line 14 of page 10) associated with each port that contain message descriptors (lines 23-24 of page 1) that each references a communications packet stored in memory (714 in Figure 7; lines 2-5 of page 9); (5) a high threshold (lines 7-10 of page 15; 1314 in Figure 13A) and a low threshold (lines 7-10 of page 15; 1316 in Figure 13A) associated with each transmit queue; (6) an indication of ports to which flow control requests (line 29 of page 15 to line 3 of page 16) have been made associated with each port (1318-1320 in Figure 13A; lines 18-26 of page 15); and (7) an indication of the number of flow control requests made to a port associated with each port (line 29 of page 15 to line 3 of page 16).

Dependent Claims 7-10

Claim 7 is directed to the network multiplexer (lines 15-26 of page 1; 114 in Figure 1; 700 in Figure 7) of claim 6 wherein, when a message descriptor (lines 23-24 of page 1) is forwarded to a port (702-707 in Figure 7; line 26 of page 8 to line 14 of page 10) for transmission, and when the transmit queue (708 in Figure 7; line 26 of page 8 to line 14 of page 10) of the port is full, the message descriptor is dropped. Claim 8 is directed to the

network multiplexer (lines 15-26 of page 1; 114 in Figure 1; 700 in Figure 7) of claim 6 wherein, when a message descriptor (lines 23-24 of page 1) is forwarded to a port (702-707 in Figure 7; line 26 of page 8 to line 14 of page 10) for transmission, and when the transmit queue of the port contains a number of message descriptors greater than or equal to the high threshold (lines 7-10 of page 15; 1314 in Figure 13A) associated with the port, a flow control request is sent (line 29 of page 15 to line 3 of page 16) to the port that received the communications packet referenced by the message descriptor and a indication that a flow control request has been sent (line 29 of page 15 to line 3 of page 16) to the port that received the communications packet is saved by the port to which the message descriptor is forwarded. Claim 9 is directed to the network multiplexer (lines 15-26 of page 1; 114 in Figure 1; 700 in Figure 7) of claim 6 wherein, when a message descriptor (lines 23-24 of page 1) is forwarded to a port (702-707 in Figure 7; line 26 of page 8 to line 14 of page 10) for transmission, and when the transmit queue (708 in Figure 7; line 26 of page 8 to line 14 of page 10) of the port has contained a number of message descriptors greater than or equal to the high threshold (lines 7-10 of page 15; 1314 in Figure 13A) associated with the port more recently than the transmit queue of the port has contained a number of message descriptors less than the low threshold (lines 7-10 of page 15; 1316 in Figure 13A) associated with the port, a flow control request is sent (line 29 of page 15 to line 3 of page 16) to the port that received the communications packet referenced by the message descriptor and a indication that a flow control request has been sent to the port that received the communications packet is saved by the port to which the message descriptor is forwarded. Claim 10 is directed to the network multiplexer (lines 15-26 of page 1; 114 in Figure 1; 700 in Figure 7) of claim 6 wherein, when a port (702-707 in Figure 7; line 26 of page 8 to line 14 of page 10) removes a message descriptor from the transmit queue (708 in Figure 7; line 26 of page 8 to line 14 of page 10) associated with the port, and when the number of messages contained in the transmit queue currently equal one less than the low threshold (lines 7-10 of page 15; 1316 in Figure 13A) associated with the port, a release flow control message is sent (line 29 of page 15 to line 3 of page 16) to each port referenced by indications saved by the port.

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. The rejection of claims 1 and 3 under 35 U.S.C. §103(a) as being unpatentable over Erimli et al., United States Patent No. 6,405,258 ("Erimli I") in view of Erimli et al.,

United States Patent No. 5,953,335 ("Erimli II").

2. The rejection of claims 6, 8, and 10 under 35 U.S.C. §103(a) as being unpatentable over Erimli I in view of Simmons et al., United States Patent No. 6,167,054 ("Simmons").

3. The rejection of claim 7 under 35 U.S.C. §103(a) as being unpatentable over Erimli I in view of Simmons and in further view of Erimli II.

ARGUMENT

Claims 1-10 are pending in the current application. In an office action dated September 17, 2009 ("Office Action"), the Examiner finally rejected claims 1 and 3 as being unpatentable over Erimli et al., United States Patent No. 6,405,258 ("Erimli I") in view of Erimli et al., United States Patent No. 5,953,335 ("Erimli II"), rejected claims 6, 8, and 10 under 35 U.S.C. §103(a) as being unpatentable over Erimli I in view of Simmons et al., United States Patent No. 6,167,054 ("Simmons"), rejected claim 7 under 35 U.S.C. §103(a) as being unpatentable over Erimli I in view of Simmons and in further view of Erimli II, and additionally allowed claims 2, 4-5, and 9. Appellants wish to thank the Examiner for the conditional allowance of claims 2, 4-5, and 9, and continue to respectfully traverse the rejections of claims 1, 3, and 6-8.

ISSUE 1

1. The rejection of claims 1 and 3 under 35 U.S.C. §103(a) as being unpatentable over Erimli et al., United States Patent No. 6,405,258 ("Erimli I") in view of Erimli et al., United States Patent No. 5,953,335 ("Erimli II").

In a previously filed response, Appellants characterized the currently claimed method and system embodiments of the present invention as follows:

> The current claims include two independent claims, claims 1 and 6. Claim 1, a method claim, includes the step "providing each transmitting port in the network multiplexer with a high threshold and a low threshold." Independent claim 6 includes the element "a high threshold and a low threshold associated with each transmit queue." The high and low thresholds associated with transmit queues are discussed beginning on line 7

of page 15 of the current application, and in the paragraph that begins on line 27 of page 15 of the current application. Both the low and high threshold contain threshold values related to the number of message descriptors queued to the transmit queue. As discussed in the paragraph that begins on line 27 of page 15:

> In the method of the present invention, when a source attempts to queue a message descriptor to a transmit queue, and the transmit queue is full, then the message descriptor is simply discarded. When a source attempts to queue a message descriptor to a transmit queue already containing a number of message descriptors greater than the high threshold, then the transmit queue sends a flow control directive to the source to direct the source to employ hardware or protocol-level flow control procedures in order to temporarily prevent reception of additional communications packets by the source. When the number of message descriptors queued within the transmit queue has equaled or exceeded the high threshold value, and then falls below one less than the high threshold value, then a source may queue a message descriptor to the transmit queue without receiving a flow control directive. When the number of message descriptors in a transmit queue has equaled or exceeded the high threshold value, and the number of entries has fallen below the low threshold value, then the transmit queue sends release flow control messages to any sources to which the transmit queue had sent flow control messages during the time when the number of queued message descriptors equaled or exceeded the high threshold. However, a transmit queue will not release sources from flow control until the number of queued message descriptors falls below the low threshold.

Thus, both the low threshold and the high threshold describe numbers of queued entries, the low threshold containing a value less than the value contained in the high threshold. The high threshold value is less than the maximum number of entries in the queue, to allow for queuing of some number of message descriptors that arrive after flow control is invoked, when the number of entries exceeds, or is equal to, the high threshold, depending on the implementation, as discussed in the paragraph beginning on line 6 of page 18.

Thus, as clearly stated in the above-quoted passage from the previously-filed response, in the currently disclosed and claimed embodiments of the present invention, each transmit queue within a network multiplexer is associated with three different values: (1) a maximum number of message descriptors that can be stored in the queue; (2) a high threshold; and (3) a low threshold. The high threshold is used to determine when flow-control directives are transmitted to a source, and the low threshold is used to determine when a release-flow-control message is sent to a source, so that the source can resume transmission of messages to

the network multiplexer. When a transmit queue is full, then messages are discarded. When a transmit queue contains a number of queued message descriptors equal to or greater than a high threshold value, any source from which a message is received for queuing to the transmit queue receives a flow-control directive. When the number of message descriptors queued to the transmit queue fall below the low-threshold value, then flow control is released from all sources flow controlled as a result of transmitting messages for queuing to the transmit queue.

The three values are used to provide several intermediate transmit-queue states which are not provided in currently available transmit queues, including those disclosed in Erimli I and II. When a transmit queue contains a number of messages equal to, or greater, than the low threshold but lower than the high threshold, the transmit queue is in a first intermediate state that allows messages to flow into, and be transmitted from, the transmit queue, but in which flow-controlled sources remain flow controlled, in the case that the number of message descriptors queued to the transmit queue exceeded the high threshold more recently than the number of message descriptors queued to the transmit queue that fell below the low threshold value. Thus, flow control is carried out to a limited extent, in the first intermediate state, while message traffic is still transmitted through the queue. When the number of message descriptors queued to the transmit queue exceeds the high-threshold value, the transmit queue is in a second intermediate state, since there is remaining capacity within the queue for message descriptors that arrive despite flow-control directives being sent out to sources of subsequently received messages. As described at great length in the current application, providing these intermediate states for the transmit queue addresses certain of the problems of network multiplexers discussed in the current application in the paragraph that begins on line 27 of page 1:

> The receive queues, transmit queues, and memory for storing communications packets within a network multiplexer represent finite internal resources of the network multiplexer. Mismatches between the rates at which communications packets are received by a network multiplexer and the rates at which received communications packets may be transmitted by a network multiplexer can result in the exhaustion of certain internal resources of the network multiplexer, such as backup of receive and transmit queues, exhaustion of memory capacity within the network multiplexer, and, ultimately, discarded communications packets. When communications packets are discarded by the network multiplexer, or dropped, without being transmitted to their intended destinations, the loss of the communications packet is generally detected by the network node that originally transmitted the communications packet after a period of time and is then sent again by the

> network node that originally transmitted the communications packet. Retransmission of dropped communications packets introduces significant delays and possibilities for further problems and error conditions to arise. When certain network-multiplexer internal resources are exhausted, messages received via certain ports may be blocked from being forwarded to other ports while resources are monopolized by other ports. Such problems can be avoided by individually gating reception of communications packets via ports using network-hardware or network-protocol level flow control techniques. However, currently-available methods require complex and costly logic in order to monitor the use of portions of resources allocated to each port. Thus, designers, architects, and manufacturers of network multiplexers recognize the need for a simple method and system to selectively flow control the network media coupled to a network multiplexer in order to prevent communications packets from being discarded as a result of the exhaustion of internal network multiplexer resources.

Again, when the transmit queue is full, incoming messages are dropped and message sources are flow controlled. When the number of message descriptors queued to the transmit queue is less than the low threshold, the transmit queue operates normally. In the first intermediate state, messages may still be queued to the transmit queue, but sources of messages are flow controlled. In the second intermediate state, messages are queued to the transmit queue, but any flow-controlled sources remain flow controlled. Association of the above-discussed three values with a transmit queue provides for the four queue states, including: (1) a queue-full state; (2) a state in which sources are flow controlled, but messages can still be queued to the transmit queue; (3) a state in which messages can be queued to the transmit queue, and previously flow-controlled message sources remain flow controlled; and (4) a normal-operation state in which no message sources are flow controlled and messages are queued to the transmit queue. Of course, in all four states, messages are transmitted by the associated transmit port and removed from the transmit queue.

As Appellants have previously argued, neither Erimli I nor Erimli II teaches, mentions, or suggests providing the above-mentioned transmit-queue intermediate states. The Examiner cites Erimli I for providing two threshold values for each queue, citing Figure 5A and lines 5-32 of column 12 of Erimli I. However, as Appellants have pointed out to the Examiner in a previously filed response, these two threshold values are, as explicitly stated in Erimli I, the maximum number of entries that are allowed in the associated output queue for each of two different priority classes. In other words, the high threshold (240A in Figure 5A) and low threshold (240B in Figure 5A) represent the maximum number of queue entries allowed for high-priority messages and low-priority messages, respectively. It should be

appreciated that this clearly fails to teach or suggest the currently claimed invention. Note that, for example, claim 1 recites providing each transmitting port in the network multiplexer with a high threshold and a low threshold. Claim 1 also recites discarding such descriptors when the transmit queue currently contains a maximum number of message descriptors, without reference to either of the high threshold or low thresholds. As discussed above, claim 1 clearly claims the above-mentioned three values associated with each transmit queue. Messages are discarded when the transmit queue currently contains a maximum number of message descriptors, but flow control is exercised with respect to a particular source when the transmit queue currently contains a number of message descriptors equal to or greater than the high threshold. Release of flow control when the number of queued message descriptors falls below the low threshold is claimed explicitly in claim 3. Erimli I does not teach, mention, or suggest discarding messages when a transmit queue is full and exercising flow control when the number of messages in a transmit queue exceeds the high threshold value. Instead, as explicitly stated by Erimli I in the cited portions of columns 12 and 15, as well as in the paragraph preceding the cited portion of column 15, Erimli I exercises flow control for each priority class of messages when the number of messages of that priority class within the transmit queue or output queue exceeds the threshold value for that priority class. In other words, the two threshold values shown in Figures 5A of Erimli I simply represent the maximum number of entries that can be queued for each of two priority classes. Erimli I exercises flow control when the number of messages for a particular priority class queued to the transmit queue exceeds the threshold value. Erimli I is simply a traditional flow-control method applied separately to two different priority classes of messages.

Erimli I does not teach, mention, or suggest associating three different values with the transmit queue, dropping messages where the number of messages queued to the transmit queue exceeds a maximum value, and exercising flow control when the number of messages queued to the transmit queue is equal to or greater than a high threshold value is different from the maximum number of messages value used for dropping messages. The Examiner notes that Erimli I does not teach, mention, or suggest discarding message descriptors, and therefore the Examiner cites claim 12 of Erimli II which suggests that a network switch discards frame pointers "for each output queue associated with a designated port if the output queue does not have available capacity." However, both Erimli I and Erimli II exercise flow control, in the case of Erimli I, or drop messages, in the case of Erimli II, entirely based on whether the transmit queue has reached maximum capacity, either in its

entirety or for particular classes of messages. Neither reference teaches, mentions, or suggests dropping messages when a transmit queue has reached maximum capacity but exercising flow control when the number of messages queued to the transmit queue has exceeded or equaled a threshold value that is different from the maximum capacity of the transmit queue.

In justifying a combination of Erimli I and Erimli II, the Examiner states, on page 7 of the Office Action:

> In view of the above, having the method and apparatus for controlling the flow of data through a network switch of Erimli '258 and method for selective discarding of frame pointers of Erimli #2 '335, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teaching features of Erimli '258 by incorporating teaching features as taught by Erimli #2 '335 in order to selectively drop frame pointers based on the queue capacity as suggested.

A combination of Erimli and Erimli II would produce a system in which flow control and message dropping are both initiated when either a transmit queue is completely filled or when that portion of a transmit queue allocated to a class of messages that includes a newly received message is full. However, the combination does not in any way teach, mention, or suggest the intermediate states, discussed above, provided by using a different criterion for dropping messages from the criterion used to exercise flow control.

In attempting to read Erimli I onto claim 3, the Examiner states, on page 8 of the Office Action:

> Erimli '258 does not explicitly send a release flow control request. However, one skilled in the art would be motivated to send a release flow control message when the threshold value of queue holding the pointers falls below the threshold in order to restart transmission based on the threshold level. Additionally, sending a flow-control release when the buffers or queue's length has been reduced or the amount of frame pointers or data packets have dropped below the high threshold mark is well within the knowledge of those skilled in the art. In other words, given what is disclosed by Erimli '258, it would have been obvious to one skilled in the art to modify the teaching features of Erimli '258 by sending a flow-control release to arrive at the claimed invention. The motivation would have been to provide efficient transmission in the network switch.

However, Erimli I does not provide any mechanism or value, such as the low threshold value associated with transmit queues in embodiments of the present invention, for knowing when to release flow control. Erimli I provides only a single threshold value for each priority class

of messages, and that threshold value represents the maximum capacity of the transmit queue for a particular priority class. For Erimli I to release flow control when the number of messages queued to the transmit queue for a particular priority class falls below a threshold value, Erimli I would need to provide such a threshold value. Erimli does not provide the above-described buffering states made possible by having two different threshold values for exercise of flow control and release of flow control as well as a maximum-capacity value. Furthermore, one skilled in the art, and having read Erimli I, would not be motivated to send a release flow-control message, as suggested by the Examiner, since Erimli I uses pause frames to exercise flow control that include a pause length, as shown in Figure 5B in Erimli I and as discussed in the paragraph that begins on line 22 of column 15 of Erimli I. Erimli I exercises flow control for pre-defined periods of time. There is no need in Erimli I for sending separate release-flow-control requests. Erimli I does not teach, mention, or in any way suggest sending release flow-control messages.

In summary, the current application and current claims are directed to providing transmit queues with two different intermediate states by using three different values associated with each transmit queue. Both Erimli I and Erimli II disclose only a single value, the maximum number of message descriptors that can be queued to a transmit queue, either in general or for each of two or more priority classes, that is used to deciding when to drop messages or to exercise flow control. Erimli I and Erimli II do not, alone or in combination, in any way suggest the currently claimed invention.

ISSUE 2

2. <u>The rejection of claims 6, 8, and 10 under 35 U.S.C. §103(a) as being unpatentable over Erimli I in view of Simmons et al., United States Patent No. 6,167,054 ("Simmons")</u>.

The rejection of claims 6, 8, and 10 depend primarily on Erimli I, which, as discussed above, does not teach, mention, or suggest that for which it is cited and does not teach, mention, or even remotely suggest the currently claimed invention.

ISSUE 3

3. <u>The rejection of claim 7 under 35 U.S.C. §103(a) as being unpatentable over Erimli I in view of Simmons and in further view of Erimli II</u>.

The rejection of claim 7 depends primarily on Erimli I and Erimli II, which, as discussed above, do not teach, mention, or suggest that for which they are cited and do not teach, mention, or even remotely suggest the currently claimed invention.

CONCLUSION

The current application and current claims are directed to a method and system in which each transmit queue of a network multiplexer is associated with three different values that allow for representation of two intermediate queue states in addition to a state in which incoming messages are dropped, and message sources are flow controlled, and a state in which all incoming messages are queued to the transmit queue and no message sources are flow controlled. Erimli I and II describe simple output queues associated with either a single output-queue capacity or with separate output-queue capacities for each of a number of different message-priority classes. Erimli I and II do not teach, mention, or suggest associating three different values with an output queue or the above-described intermediate states that are obtained using these three different values. Erimli I and II do not, in any way, disclose or suggest the currently claimed invention.

Appellants respectfully submit that all statutory requirements are met and that the present application is allowable over all the references of record. Therefore, Appellants respectfully request that the present application be passed to issue.

Respectfully submitted,
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CLAIMS APPENDIX

1. A method for initiating flow control in a network multiplexer that forwards a message descriptor referencing a communications packet received by a receiving port to one or more transmit queues, each transmit queue associated with a transmitting port which transmits communications packets queued to the transmit queue, the method comprising:

providing each transmitting port in the network multiplexer with a high threshold and a low threshold;

when a message descriptor is queued to a transmit queue associated with a transmitting port,

when the transmit queue currently contains a maximum number of message descriptors, discarding the message descriptor, and

when the transmit queue currently contains a number of message descriptors equal to or greater than the high threshold of the associated transmitting port, sending a flow control request to the receiving port that received the communications packet referenced by the queued message descriptor.

2. The method of claim 1 further including:

when a message descriptor is queued to a transmit queue associated with a transmitting port,

when the transmit queue currently contains a number of message descriptors greater than or equal to the low threshold of the associated transmitting port, but the number of message descriptors contained in the transmit queue exceeded or equaled the high threshold of the associated transmitting port more recently than the number of message descriptors contained in the transmit queue was equal to the low threshold of the associated transmitting port, sending a flow control request to the receiving port that received the communications packet referenced by the queued message descriptor.

3. The method of claim 1 further including:

when a transmitting port transmits a packet referenced by a message descriptor to a destination port,

releasing the message descriptor, and

when the destination port currently contains a number of queued message descriptors equal to one less than the destination port's low threshold, sending a release flow control request to any receiving ports to which a flow control request was sent while the transmit queue contained a number of message descriptors equal to or greater than the high threshold of the associated transmitting port.

4. The method of claim 2 further including:

when a transmitting port transmits a packet referenced by a message descriptor to a destination port,

releasing the message descriptor, and

when the destination port currently contains a number of queued message descriptors one less than the destination port's low threshold, sending a release flow control request to any receiving ports to which a flow control request was sent while the transmit queue contained a number of message descriptors greater than or equal to the low threshold of the associated transmitting port.

5. The method of claim 4 further including:

when a receiving port is flow controlled and receives a number of release flow control requests equal to the number of received flow control requests,

releasing flow control by the receiving port.

6. A network multiplexer system that links physically separate network media by forwarding packets received from each network medium to a number of network media, the network multiplexer system comprising:

a number of ports, each port having a transceiver and a communications controller;

a memory;

an internal bus for transferring packets from ports to memory and from memory to ports;

a receive queue and a transmit queue associated with each port that contain message descriptors that each references a communications packet stored in memory;

a high threshold and a low threshold associated with each transmit queue;

an indication of ports to which flow control requests have been made associated with each port; and

an indication of the number of flow control requests made to a port associated with each port.

7. The network multiplexer of claim 6 wherein, when a message descriptor is forwarded to a port for transmission, and when the transmit queue of the port is full, the message descriptor is dropped.

8. The network multiplexer of claim 6 wherein, when a message descriptor is forwarded to a port for transmission, and when the transmit queue of the port contains a number of message descriptors greater than or equal to the high threshold associated with the port, a flow control request is sent to the port that received the communications packet referenced by the message descriptor and a indication that a flow control request has been sent to the port that received the communications packet is saved by the port to which the message descriptor is forwarded.

9. The network multiplexer of claim 6 wherein, when a message descriptor is forwarded to a port for transmission, and when the transmit queue of the port has contained a number of message descriptors greater than or equal to the high threshold associated with the port more recently than the transmit queue of the port has contained a number of message descriptors less than the low threshold associated with the port, a flow control request is sent to the port that received the communications packet referenced by the message descriptor and a indication that a flow control request has been sent to the port that received the communications packet is saved by the port to which the message descriptor is forwarded.

10. The network multiplexer of claim 6 wherein, when a port removes a message descriptor from the transmit queue associated with the port, and when the number of messages contained in the transmit queue currently equal one less than the low threshold associated with the port, a release flow control message is sent to each port referenced by indications saved by the port.

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

None.